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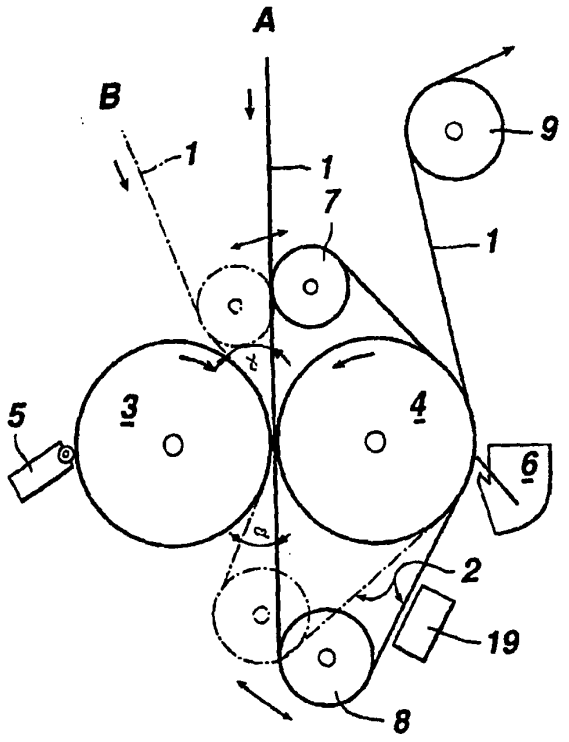
(54) Title: METHOD AND ARRANGEMENT FOR COATING A MOVING WEB

(57) Abstract

Method and arrangement for coating a paper or board web, wherein the web (1) to be coated is brought to a film transfer coater and taken to a nip (12) between the film transfer roll (3) of the coater and its backing roll (4), and coating mix is applied onto the surface of the film transfer roll (3). The web (1) is taken through the nip (12) between the rolls (3, 4) and the rolls (3, 4) are turned whereby the coating mix applied onto the applicator roll (3) is at least partly transferred onto the surface of the web (1). According to the invention the web (1) is supported through the nip (12) by means of a belt (2) travelling at the same speed as the web, the belt having been arranged to travel round the backing roll (4). The web (1) is taken onto the surface of the belt (2) prior to the nip (12) and separated from the belt (2) after the nip, and it is pressed against the film transfer roll (3) by means of the belt (2) and the length of the path covered in contact with each other by the web (1) and the film transfer roll (3) is controlled by varying the position of the web (1) and the belt (2).



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Method and arrangement for coating a moving web

The present invention relates to a method according to the preamble of claim 1 for coating a moving board or paper web by the film transfer coating method.

The invention also relates to a method for coating the web twice whereby the film transfer coater of the invention is used in the first or the second coating step.

The invention also relates to an arrangement for implementing the method.

Paper or board can be coated with one or more coating layers in order to improve its printability. The more coating layers are applied, the higher the attained paper quality, simultaneously enabling the use of coating agents having different properties. However, the use of two coating layers entails a significant increase in production costs because the coating is usually carried out in separate steps and the applied coating layer has been dried prior to the application of the next layer.

The coating can be performed either directly onto the surface of the paper by means of e.g. a blade or a rod coater or by means of a film transfer coater whereby film which has been premetered onto a film roll is transferred onto the paper surface in a roll nip. It is typical of the blade and rod coating methods that the doctor blade fills the roughness volume of the coating underlayer and evens out the surface whereby the thickness of the coat varies in accordance with the roughness volume variations of the coating underlayer. A smooth coat results having an uneven brightness coverage, and the uniform absorption properties of the coat are difficult to control.
In film transfer coating, a coat of an essentially more

In film transfer coating, a coat of an essentially more uniform thickness is obtained rendering it easy to control the absorption properties, but sufficient smoothness properties pose a problem particularly in the case of thicker papers and boards. The coating also provides quite an even coverage whereby, for example, the brightness of a coating underlayer of low brightness can be significantly improved by means of this coating method. Furthermore, as no doctor blade trailing along the coating underlayer is involved in film transfer coating, the method offers excellent runnability as regards coating breaks. A problem hampering film transfer coating, however, is posed by the fuming of the coating and the so called orange peel pattern which is due to splitting of the surface of the coating on the web detached from the film transfer roll and the film forming the coat on the roll surface, said orange peel pattern being observable as small craters in the coating. Such fuming and the formation of an orange peel pattern restrict to some extent the maximum coating speed.

Two separate ways of exploiting the special properties of the blade and film transfer coating methods have been sought.

Film transfer coating is widely used in precoating and in front coating. When used as precoat it improves the coating result due to the total coat weight alone, and the inclusion of even just one blade coat is a guarantee for sufficient smoothness. The precoat is usually dried before the following surface coat which is usually applied by means of a blade coater. From US Patent Specification No. 2,937,955, it is also known to perform blade coating directly onto the half-wet film precoating. A prerequisite for this method is that the precoat is sufficiently set to withstand surface coating by a blade. The setting can be enhanced e.g. by partial drying of the precoat if the coat

has not undergone sufficient dehydration due to filtration caused by pressure penetration in the coating nip and water absorption in the free gap between the pre- and surface coaters.

The delay and setting time between the film precoating and the blade surface coating can be extended e.g. by increasing the length of the travel of the web between the coaters, whereby the a sufficiently set and dried precoat is achieved during the extended absorption time into the web for the next blade coating step. US Patent Specification No. 5,340,611 describes a method where the amount of film coating is kept so small that the doctor blade of the blade coater does not remove the precoat by doctoring. In this manner, however, the great amount of applied coating allowed by the film transfer coater cannot be exploited, and the resulting thickness of the first coating layer is very small. In the second step, it is also possible to use a rod instead of a blade.

In pilot-scale test runs for coating paperboard, the 10 g/m^2 precoat could not be made to set sufficiently by the method even if the delay time between the coating events was extended, in order for the next blade coating step not to partly remove the already applied precoat by doctoring. A further problem was that when the web speed was determined by the film coating nip and when the web speed was reduced by the following blade coating event, a tendency appeared for a bag or a loose section to be formed in front of the blade resulting in web breaks. Thus, in this case the method did not work. The probability of web breaks is further increased because the blade coating which strains the web to a much greater extent than film transfer coating is performed while the web is damp, the strength of a damp web naturally being inferior to the strength of a dry web.

A second alternative for exploiting the special properties of film and blade coats is described in the applicant's Patent Application No. 941803 wherein the coating unit is constructed such that either film transfer coating or blade coating can be used as alternative methods depending on what is required of the final product and/or on considerations relating to runnability, whereby, however, the same coat drying apparatus is used for both methods. This apparatus can not be used to exploit the benefits of two-layer coating wherefore it chiefly increases the flexibility of production but does not improve the quality of the final product as compared to corresponding single-layer coating methods.

Particularly in the case of thick papers and boards the need exists to combine the benefits provided by film transfer coating and blade coating. Due to the space required as well as the investment costs incurred, however, intermediate drying of the precoat is not always possible. In this case the only alternative available is the above-described wet-on-wet coating, but current methods will not achieve sufficient total coat weights to allow the best possible exploitation of the good coverage obtained by film transfer coating and the good smoothness properties achieved by blade coating.

The film transfer coating method can also be used to provide the surface coat whereby the layer produced by the film transfer coating method and applied onto the first layer which has been evened out by means of a blade or rod is smooth. The solution according to the invention is particularly well suited for wet-on-wet coating whereby the second coating layer is applied onto an at least partly wet first coating layer.

The present invention aims at achieving a film transf r

coating method by which the coating event can be controlled more reliably than has been the case, thus obtaining improved runnability and increased coating speed of the film transfer coater.

The invention is based on taking the web being coated through the film transfer nip supported by a belt, and the angle of the belt over the applicator roll is controlled such that the contact distance between the web and the roll can be altered.

Further in the double coating method according to the invention the web is taken through two successive coating steps supported by a belt and one coating step is performed by means of a film transfer coater and the other e.g. by means of a short-dwell coater.

In more detail, the method according to the invention is characterized by what is stated in the characterizing part of claim 1.

The apparatus according to the invention, then, is characterized by what is stated in the characterizing part of claim 18.

The invention offers considerable benefits.

The controllability of the roll applicator station can be essentially improved by means of the belt because by varying the incoming angle and the angle of departure of the belt it is possible to affect the introduction of the web being coated into the nip, its detachment from the surface of the applicator roll, and the wetting time and pressure. By extending the wetting time, i.e. the delay time of the film transfer event, a better absorption of the coating into the web is achieved, whereby a thicker first

coating layer can be made to adhere to the surface of the web. Particularly in double coating this has a significant effect because, due to the better absorption, a sufficient amount of coating can be made to remain on the web surface even after blade coating. If, then, the blade coating step precedes the film transfer coating, the belt provides improved coating smoothness because it can be used to control the angle of detachment of the web from the applicator roll such that the formation of, e.g. an orange peel pattern is minimal. The use of a belt and the belt angle control before the web enters the nip and when it leaves the nip serve to provide further improved runnability of the web, and controlled web detachment reduces the formation of the orange peel pattern. Naturally, a rod can be used as the doctoring means instead of a blade.

In applicator roll application the belt replaces the soft roll. The belt is easier to replace once it is worn and it is considerably less costly than a roll. Thus, the belt can be replaced after short periods of use. Good runnability is provided in double coating because in the first step, the wetted web is supported by a belt whereby the web itself is subjected to less strain. A belt-supported web does not form bags as easily as a web which lacks support. In the precoating step, an inexpensive coating mix can be used to even out the surface of the paper, and blade coating is performed using a more costly finely divided coating mix, whereby good printability and coverage properties are obtained.

Belt support during the entire film transfer process provides additional possibilities of coating or surface sizing even the lightest paper grades. The supporting can be utilized to better control the detachment of the web from the film transfer roll without the web flapping

between the roll surface and the supporting belt. Uncontrolled detachment exposes the web to mechanical strain which may lead to marking of the treated surface or even break the web. The extended contact distance after the roll nip reduces fuming of the coat with the increasing distance between the nip and the point of detachment and the decreasing angle of detachment because the separation force is then reduced at the splitting point of the film.

By changing the distance of the contact point between the belt-supported web and the film transfer coater from the roll nip it is possible to increase the amount of coating mix transferred onto the web. When the web touches the coating film on the roll surface, water contained in the coating begins to be transferred to the web due to capillary and pressure penetration. A layer of packed pigment particles is formed of the web surface at the coating/web interface, which reduces the flow speed of the liquid phase and the solid phase onto the web. The contact distance can be varied in order to provide or to maintain the desired contact time at a greater speed or a greater coat weight or when the driving parameters are altered in some other way. Belt stretch can be used to control the application pressure but the pressure pulse caused by the belt is always smaller than that of the roll nip.

The increased contact distance makes a greater run speed and a greater coat weight possible with one application event without runnability problems such as fuming of the coat from the nip of formation of patterns on the coated surface. Due to the increased contact distance, an improved coat coverage is also obtained and the penetration of the coating into the web is reduced and the coating is kept on the web surface.

In the following, the invention is described in more detail

by means of the annexed drawings.

Fig. 1 is a schematic view of a film transfer coater according to the invention.

Fig. 2 is a schematic representation of a double coating method according to the invention.

Fig. 3 depicts belt-supported coaters for treating the underside and the top side of the web.

Fig. 4 depicts a second film transfer coater according to the invention.

Fig. 5 depicts a third film transfer coater according to the invention.

Fig. 6 depicts a fourth film transfer coater according to the invention.

Fig. 7 depicts a fifth film transfer coater according to the invention.

Fig. 8 depicts a sixth film transfer coater according to the invention.

Fig. 9 depicts a seventh film transfer coater according to the invention.

Fig. 10 depicts a tenth film transfer coater according to the invention.

The general principle behind this invention lies in supporting the web during coating or surface sizing for applying the coating mix onto the web as a premetered layer or for blade coating, whereby the applied coating mix layer

is evened out using a doctor blade. During the coating process the coating suspension is applied onto the web in two steps such that both sides of the web are treated separately. In multi-layer coating several treatment steps are applied. The belt is arranged as a supporting means either under or on top of the web in accordance with Fig. 3 depending on which side is to be coated. The belt can be used as a supporting means between the web and the backing roll or the web can be pressed against the film transfer roll directly by means of the belt without using a special backing roll. If the belt is the only means supporting the web and providing the application pressure, application pressure is controlled by controlling web tension. The contact distance can be controlled and the web supported by means of an additional idle roll or backing roll for instance so as to ensure a straight and precise contact line between the web and the film transfer roll.

The coating mix is applied onto the surface of the film transfer coater before the roll touches the web and in this case the belt can be used to control the contact distance and angle before the nip between the film transfer roll and the backing roll, and after said nip. The contact distance is varied by varying the incoming angle and the angle of departure of the web and the belt in relation to the film transfer roll. The web and the belt can of course be taken through the coater at predetermined angles.

In some cases the coating mix may stain the surface of the belt whereby belt cleansing is required. The smoothness and other physical properties of the belt are altered if it is not cleaned, and the altered properties will affect the quality of the coat provided onto the web, as well as the reproducibility of said quality. The belt can be cleaned using a doctor knife (Fig. 7) or liquid, air or steam jets (Fig. 8) whereby no mechanical contact with the belt is

required. According to the invention the web can also be dried (Fig. 9) before it is separated from the supporting belt, making different web paths possible without damaging the coat, and the treated side of the web can for instance be brought in contact with the roll or cylinder surface after drying when the web is delivered off the belt. The dryer may comprise an infrared or some other radiating device, a microwave or another such electromagnetic radiating dryer, a blast dryer, a coanda dryer or some other dryer where the web is supported by means of the flow, a one-sided inverted drying funnel, or a corresponding device.

Fig. 1 depicts a belt-supported film transfer coater where the incoming angle α of the web 1 to be coated to the film transfer coater 3 and the angle β of departure from the roll 3 can be controlled by altering the tension of the belt 2 supporting the web 1. The coater comprises an applicator roll 3, a backing roll 4 forming a nip therewith, and a belt 2. The coating mix is applied onto the surface of the film transfer roll 3 by means of a blade or rod applicator, a jet applicator, spray applicator, gate-roll applicator, or even by means of pool application, and it is transferred from the roll surface onto the web surface. The belt 2 is arranged to travel via several guide rolls and its speed is adjusted such that it is equal to the speed of the web being coated. The guide rolls 7, 8 are arranged on both sides of the roll nip. The guide roll 7 on the incoming side of the web 1 can be moved by means of a spiral bar 10, thereby altering the incoming angle α of the web. The incoming angle is the sector of the applicator roll which is covered by the web 1 and the belt 2 supporting the web at each control position of the guide roll 7 on the incoming side prior to the center point of the nip 12. Correspondingly, the guide roll 8 on the departure side can be moved by means of a guide track 11,

thus varying the angle β of departure which is the sector on roll 3 defined by the center point of the nip 12 and the point of detachment of the web 1. These angles can also be called the precoverage area and the postcoverage area. Furthermore, in Fig. 1 no actuators are shown for varying the position of the guide rolls 7 and 8 by means of remote control or an automatic system e.g. while the apparatus is in operation, but such controls are simple to implement e.g. by means of spiral rods and controllable electric motors. The force applied when the web 1 is pressed against the applicator roll is controlled by altering the tension of the belt by means of both the guide rolls 7, 8 and the backing roll 4. The backing roll 4 may serve as a pressing roll by means of which the nip pressure is controlled whereby no control implemented by varying the tension of the belt is necessary, or it may be used as a second controlling alternative. By using both belt tension control and control of the nip pressure implemented by means of the backing roll, a changing pressure is obtained over the length of the path of the applicator roll 3 and the web covered under mutual contact.

As the distance covered by the belt 2 changes when the guide rolls 7, 8 are shifted, the change must be compensated by moving at least one other guide roll. In this case the compensation is performed by means of a dancer roll 13 which has been arranged to move along a guide track. The belt 2 tension is kept right by means of a tension roll 14 furnished with a pair of bellows 15. In addition to the above-mentioned rolls the belt 2 is guided by creasing rolls 16 and 17 which may also be movable. In Fig. 1 the web being coated is brought onto the belt 2 from the left and the web 1 is taken onto the surface of the belt 2 via the creasing roll 18 such that the web 1 travels between the roll 18 and the belt 2 which is creased over the roll.

By varying the angle of incidence of the belt 2 the web 1 can be made to come into contact with the film transfer roll 3 as smoothly as possible and by controlling the angle of departure the formation of a surface pattern can be controlled. The main effect these control measures have, however, concerns the time during which the web 1 and the film transfer roll 3 are in contact. By varying the contact time and the length of the contact distance it is possible to control the transfer of the coating from the roll 3 onto the web. The belt also reduces possible vibrations due to the splitting of the coating film, which for its part renders greater web speeds possible. In addition, such angles of incidence and departure can be sought that, under certain operating conditions, as little coating fume as possible is generated when the web is detached from the press nip.

By means of the invention it is possible to carry out the duplex coating method using conventional coating apparatuses. In the embodiment depicted in Fig. 2, the blade coater comprises a short-dwell coater and the film transfer coater is an apparatus where the coating is metered onto the film transfer roll 3 by means of an applicator rod 5. The web 1 to be coated is brought to the film transfer roll 3 by means of an arrangement comprising a backing roll 4, belt-guiding rolls 7, 8, and a belt 2. The belt-guiding rolls 7, 8 are arranged on both sides of the backing roll 4 on the incoming side of the web 1 and on the departure side. The diameter of the guide rolls 7, 8 is smaller than that of the backing roll 4 whereby the belt 2 travels guided by the rolls along a triangular path and touches the backing roll 4 at two points on opposite sides of its axis. The first touching point is the nip formed by the backing roll 4 and the film transfer roll 3, wherein the backing roll 4 presses the belt 2 against the film transfer roll. On the opposite side of this nip there is

the short-dwell coater 6 by means of which a second coating layer is applied onto the surface of the web 1 against the belt 2 and the backing roll 4. The web leaves the short-dwell coater 6 via the guide roll 9 for the web 1.

As will emerge from Fig. 2, the belt-guiding rolls 7, 8 are movable. In the first extreme position of the guide rolls 7, 8 their external surfaces are on the same line as the external surface of the backing roll 4, whereby the belt 2 and the web 1 traveling on said belt enter the nip between the film transfer roll 3 and the backing roll 4 along a straight line from direction A. Both belt-guiding rolls 7, 8 can be moved toward the film transfer roll 3 either independently or simultaneously with the other roll. By moving the roll 7 on the incoming side it is possible to influence the angle of incidence of the web as well as the length of the application distance and the application time before the nip. The second extreme position of the incoming angle of the web is depicted with a dashed line, and in this extreme position the web 1 comes in from direction B. The second extreme position of the guide roll 8 on the departure side is also depicted with a dashed line. In addition to the application time, the angle on the departure side can also be used to affect splitting of the coating layer when the web leaves the film transfer roll 3. The angle of departure is selected such that an applied coating layer which is as smooth as possible is obtained.

In addition to the incoming angle and the angle of departure of the web and the application time, it is also possible to control the application pressure between the film transfer roll 3 and the belt 2. This is only possible when a belt is used, for the pressure in a nip between two rolls only affects a short section in the nip, and even if the touching angle between the web and the applicator roll was longer, only little force can be exerted to press the

web against the applicator roll by increasing the web tension. In the solution of the invention, a pressure effect of long duration is exerted towards the web, by means of which pressure effect the water contained in the coating is efficiently absorbed by the web and the coating is dried, whereby the first coating layer will withstand coating performed using a doctor blade without difficulty.

In fig. 4 a coater is depicted where even the coating mix applicator 19 is schematically shown and where the path of the belt and the control of the incoming angle and the angle of departure of the web is arranged in a manner differing slightly from that depicted in Fig. 1. In this solution, most of the rolls guiding the web are fixed to a uniform frame 20 arranged above the coater, which frame is attached to the stationary frame construction by means of a joint 24. The frame 20 can be turned in relation to the joint, thereby changing the incoming angle of the web 1 and the belt 2 to the film transfer roll 3 as well as the contact distance. On the departure side of the film transfer roll 3 the belt 3 and the web 1 are guided by means of a roll 21 fixed to a swivel shaft 22. The control of the angle of departure is thus carried out by turning the shaft 22. The tension of the belt 2 and the compensation of the distance covered by the belt 2 are performed by means of a movable roll 23 fixed to the frame 20. In this solution no backing roll is used; instead, the application pressure is obtained directly by varying the belt tension.

Fig. 5 depicts the arrangement of Fig. 4 and the frame 20 which supports the rolls guiding the belts 2 in two different positions. In addition this solution is provided with a backing roll in order to obtain a greater application pressure. As will emerge from Fig. 5, when a backing roll is used, the control range of the incoming

angle is in principle greater because the web 1 and the belt 2 can be taken directly into the nip between the backing roll 4 and the film transfer roll 3. If no backing roll is used, the length of the path covered under mutual contact must usually be greater in order to ensure a sufficient and smooth transfer of coating, whereby the belt 2 must be creased more over the film transfer roll 3.

Fig. 6 depicts a solution where the rolls guiding the supporting belt 2 are arranged in fixed positions. In this solution the length of the path covered under mutual contact and the incoming angle and the angle of departure can only be altered by altering the mounting points of the rolls. Hereby the belt 2 naturally does not circulate round the backing roll but travels in a loop such that its outside presses the web 1 against the film transfer roll 3.

In the solution of Fig. 7 a doctor knife 25 cleansing the belt is shown, the doctor knife being arranged after the point of separation of the belt 2 and the web 1. The doctor knife 25 is needed in particular in the case of paper grades which are easily penetrated by coating mix, whereby the belt supporting the web is easily soiled. As the belt may become soiled even due to other reasons than penetration of coating, it may be advisable to use a doctor blade in any case. In Fig, 8 the doctor blade is replaced by a cleanser 26 which may use a liquid jet or an air or steam jet, whereby there is no need to mechanically touch the belt. A solution is shown in Fig. 9 where the loop of the supporting belt 2 is continued by two guide rolls 27 and 28 after the roll 21 which controls the angle of departure. The web leaves the belt 2 at the roll 28 after the second guide roll 21 on the side of departure and before this roll a dryer operating against the web 1 and the belt 2 is arranged. The dryer may comprise an infrared or some other radiating device, a microwave or some other

electromagnetic radiating dryer, a blast dryer, a coanda dryer or some other dryer where the web is supported by means of the flow, a one-sided inverted drying funnel, or a corresponding device.

An arrangement is depicted in Fig. 10 where the belt 2 and the web 1 are pressed against the film transfer roll 3 by means of an auxiliary backing roll 30 in order to form a precise and straight contact line between the web 1 and the film transfer roll 3. The auxiliary backing roll must be movable and, if necessary, it must be possible to control the nip pressure between the auxiliary backing roll and the film transfer roll 3, like the nip pressure between the film transfer roll and the backing roll.

In addition to the above the invention also has other embodiments.

The duplex coating may also be performed by first applying a first coating layer onto the web by means of a blade coating method, e.g. by means of a short-dwell coater, whereafter a second coating layer is applied by means of a film transfer roll. In this manner a smooth surface is obtained even if a film transfer roll is used to apply the second layer, because the blade coating evens out the surface of the web, whereby even a smooth second layer is obtained. The surface quality is further improved by the fact that by means of the belt it is possible to effectively control applicator roll coating, whereby a coating of a quality exceeding previous coating qualities is obtained. In addition to film transfer coating, any known coating method may be used as the application method, but methods based on blade or rod doctoring provide the greatest benefits because they can be used to combine the contour-type coverage of film transfer coating with the smooth surface obtained by blade doctoring. Blade coating

may be performed by means of short-dwell type apparatuses such as are described above or by some other means, e.g. by using roll application, die application or a corresponding method and successive doctoring using a rod or a blade.

It is clear that the path of the belt and the number of guide and backing rolls may be selected freely according to needs, but if, e.g., each applicator has its own backing roll, a more expensive construction results. One or several guide rolls may be provided and they can be moved independently or synchronously connected to each other. Instead of a rod, the doctor means of the film transfer coater may comprise some other doctor means. Intermediate drying may be applied between the blade coating and the film transfer coating, whereby the amounts of coating applied may be increased and better use can be made of the prelayer.

Claims:

1. A method for coating a paper or board web, comprising:

- introducing the web (1) to be coated to a film transfer coater and taking it to the film transfer roll (3) of the coater,

- applying coating mix onto the surface of the film transfer roll (3), and

- taking the web (1) forward in contact with the film transfer roll (3) and rotating the roll (3) whereby the coating mix applied onto the applicator roll (3) is at least partly transferred onto the web (1) surface,

c h a r a c t e r i z e d by

- supporting the web (1) by means of a belt (2) traveling at the same speed as the web (1), the belt having been arranged to travel in a continuous loop such that the side of the belt (2) which in the loop is faced towards the outside supports the web (1) against the film transfer roll,

- taking the web (1) onto the surface of the belt (2) before it touches the film transfer roll (3) and separating it from the belt (2) after the web (1) has left the film transfer roll (3), and

- pressing the web (1) against the film transfer roll (3) by means of the belt (2) and altering the length of travel in contact with each other of the web (1) and the film transfer roll (3) by changing

the position of the web (1) and the belt (2).

2. The method of claim 1, comprising

- bringing the web (1) to be coated to the film transfer coater and taking it to a nip (12) between the film transfer roll (3) of the coater and its backing roll (4),

- applying coating mix onto the surface of the film transfer roll (3), and

- taking the web (1) through the nip (12) between the rolls (3, 4) and turning the rolls (3, 4) whereby the coating mix applied onto the applicator roll (3) is at least partly transferred onto the surface of the web (1),

c h a r a c t e r i z e d by

- supporting the web (1) through the nip (12) by means of a belt (2) traveling at the same speed as the web, the belt having been arranged to travel round the backing roll (4),

- taking the web onto the surface of the belt (2) before the nip (12) and separating it from the belt (2) after the nip, and

- pressing the web (1) against the film transfer roll (3) by means of the belt (2) and controlling the distance covered by the web (1) and the film transfer roll (3) in contact with one another by altering the position of the web (1) and the belt (2).

3. The method of claim 2, c h a r a c t e r i z e d by pressing the web (1) against the film transfer roll by means of a backing roll (4).

4. The method of any one of claims 1 to 3, c h a r a c - t e r i z e d by altering the length of the path covered in contact with each other of the web (1) and the film transfer roll (3) by altering the incoming angle (α) of the web (1) and the belt (2) onto the film transfer roll.

5. The method of any one of the claims 1 to 4, c h a r - a c t e r i z e d by controlling the length of the path covered in contact with each other of the web (1) and the film transfer roll (3) by altering the angle (β) of departure of the web (1) and the belt (2) from the film transfer roll (3).

6. The method of any one of the previous claims 1 to 3, c h a r a c t e r i z e d by altering the length of the path covered in contact with each other of the web (1) and the film transfer roll (3) by altering the incoming angle (α) of the web (1) and the belt (2) onto the film transfer roll (3) and their angle (β) of departure from the film transfer roll (3).

7. The method of any one of the previous claims for duplex coating a paper or board web, the method comprising:

- applying a first coating layer onto the web by means of a first coating apparatus, and

- thereafter applying a second coating layer onto the coated web surface using a second coater,

c h a r a c t e r i z e d by

- applying the coating mix by the film transfer method in one coating step, and

- guiding the web (1) from the first coating step to the second coating step guided by the belt and supporting the web (1) by means of the belt (2) during both coating steps.

8. The method of claim 7, c h a r a c t e r i z e d by applying the coating mix in the second step onto an undried first layer of coating mix.

9. The method of claim 7, c h a r a c t e r i z e d by drying the coating layer applied in the first step before applying the second layer.

10. The method of any one of the previous claims 7 to 9, c h a r a c t e r i z e d by applying the first coating layer by means of a film transfer coater.

11. The method of claim 10, c h a r a c t e r i z e d by evening out the second coating layer by means of a doctor blade or rod.

12. The method of any one of the previous claims 7 to 11, c h a r a c t e r i z e d by applying the first and the second layer of coating mix onto the web (1) against a belt supported by the same backing roll (4).

13. The method of any one of the previous claims, c h a r a c t e r i z e d by cleaning the belt (2) by means of a doctor knife (25) once the web (1) has been separated from the belt (2).

14. The method of any one of the previous claims 1 to 12, c h a r a c t e r i z e d by cleaning the belt (2) by

means of a cleanser apparatus operating with liquid, air or steam jets once the web (1) has been separated from the belt (2).

15. The method of any one of the previous claims, c h a r a c t e r i z e d by drying the web before separating it from the belt (2) by means of an infrared or some other radiating device, a microwave or some other electromagnetic radiating dryer, an overhead blast dryer, a coanda dryer or some other dryer where the web is supported by means of the flow, a one-sided inverted drying funnel, or a corresponding device.

16. The method of any one of the previous claims, c h a r a c t e r i z e d by pressing the web (1) and the belt (2) against the film transfer roll (3) by means of an auxiliary backing roll (30) in order to form a precise contact line.

17. An arrangement for coating a paper or board web, the arrangement comprising:

- guide rolls (7, 18) for taking the web (1) to be coated to the film transfer coater and for bringing it in contact with the film transfer roll (3),

- a device (5) for applying coating mix onto the surface of the film transfer roll (3), and

- means (2, 7, 8, 13 to 18) for taking the web (1) forward in contact with the film transfer roll (3) and for turning the roll (3), whereby the coating applied onto the film transfer roll (3) is at least partly transferred onto the surface of the web (1),

c h a r a c t e r i z e d by

- a belt (2) for supporting the web (1) against the film transfer roll (3), the belt being arranged to travel in a continuous loop such that the side of the belt (2) turned outwards supports the web (1) against the film transfer roll (3),

- a first guide roll (18) for bringing the web (1) onto the surface of the belt (2) before the nip (12) and a second guide roll (8) for separating the web (1) from the belt (2) after the nip, and

- means (4, 7, 8) for pressing the web (1) against the film transfer roll (3) by means of the belt (2) and for varying the position of the web (1) and the belt (2) in order to control the length of the path covered in mutual contact by the web (1) and the film transfer roll (3).

18. The arrangement of claim 17, comprising:

- guide rolls (7, 18) for taking the web (1) to be coated to the film transfer coater and for bringing it into the nip (12) between the film transfer roll (3) of the coater and its backing roll (4),

- a device (5) for applying coating mix onto the surface of the film transfer roll (3), and

- means (2, 7, 8, 13 to 18) for taking the web (1) through the nip (12) between the rolls (3, 4)and for turning the rolls (3, 4), whereby the coating applied onto the film transfer roll (3) is at least partly transferred onto the surface of the

web (1),

characterized by

- a belt (2) for supporting the web (1) through the nip (12), the belt being arranged to travel round the backing roll (4),

- a first guide roll (18) for bringing the web (1) onto the surface of the belt (2) before the nip (12) and a second guide roll (8) for separating the web (1) from the belt (2) after the nip, and

- means (4, 7, 8) for pressing the web (1) against the film transfer roll (3) by means of the belt (2) and for varying the position of the web (1) and the belt (2) in order to control the length of the path covered in mutual contact by the web (1) and the film transfer roll (3).

19. The arrangement of claim 18, characterized in that the position of the first guide roll (7) can be controlled so as to control the length of the path covered in mutual contact by the web (1) and the film transfer roll (3) by altering the incoming angle (α) of the web (1) and the belt (2) to the film transfer roll (3).

20. The arrangement of claim 18 or 19, characterized in that the position of the second guide roll (8) can be controlled so as to control the length of the path covered in mutual contact by the web (1) and the film transfer roll (3) by altering the angle (β) of departure of the web (1) and the belt (2) from the film transfer roll (3).

21. The arrangement of claim 18, characterized

in that the length of the path covered in mutual contact by the web (1) and the film transfer roll (3) can be controlled by altering the incoming angle (α) of the web (1) and the belt (2) onto the film transfer roll (3) and their angle (β) of departure from the film transfer roll (3).

22. The arrangement according to any one of the previous claims 18 to 21 for duplex coating a paper or board web, the arrangement comprising:

- a first coater for applying a first coating layer onto the surface of the web, and

- a second coater for applying a second coating layer onto the coated surface of the web,

c h a r a c t e r i z e d by

- at least one film transfer coater (3, 5) for applying at least one coating layer, and

- a belt (2) arranged to travel while supporting the web (1) being coated from the first coater (3, 5) to the second coater (6) and to support the web (1) during both coating steps.

23. The arrangement of claim 22, c h a r a c t e r i z e d by a dryer for drying the coating layer applied in the first step before applying the second layer.

24. The arrangement of any one of the claims 22 and 23, c h a r a c t e r i z e d in that the belt (2) is arranged to travel round one backing roll (4) such that it touches the backing roll (4) at two points and the first applicator device (3, 5) is arranged at the first contact point and

the second one at the second contact point.

25. The arrangement of any one of the claims 18 to 24, c h a r a c t e r i z e d in that the first applicator device is a film transfer coater (3, 5) and the second one is a coater (6) comprising doctor means.

26. The arrangement of any one of the claims 18 to 25, c h a r a c t e r i z e d in that it comprises means for controlling the nip pressure between the film transfer roll (3) and the backing roll (4).

27. The arrangement of any one of the claims 17 to 26, c h a r a c t e r i z e d by a doctor knife (25) for cleaning the belt (2) after the web (1) has been separated from the belt (2).

28. The arrangement of any one of the claims 17 to 27, c h a r a c t e r i z e d by a cleanser apparatus (26) operating with liquid, air or steam jets for cleansing the web once the web (1) has been separated from the belt (2).

29. The arrangement of any one of the previous claims 17 to 28, c h a r a c t e r i z e d by a dryer (29) for drying the web (1) before it is separated from the belt (2), the dryer comprising an infrared or some other radiating device, a microwave or some other electromagnetic radiating dryer, an overhead blast dryer, a coanda dryer or some other dryer where the web is supported by means of the flow, a one-sided inverted drying funnel, or a corresponding device.

30. The arrangement of any one of the previous claims 17 to 29, c h a r a c t e r i z e d by an auxiliary backing roll for pressing the web (1) and the belt (2) against the film transfer roll (3) in order to form a precise and

straight contact line.

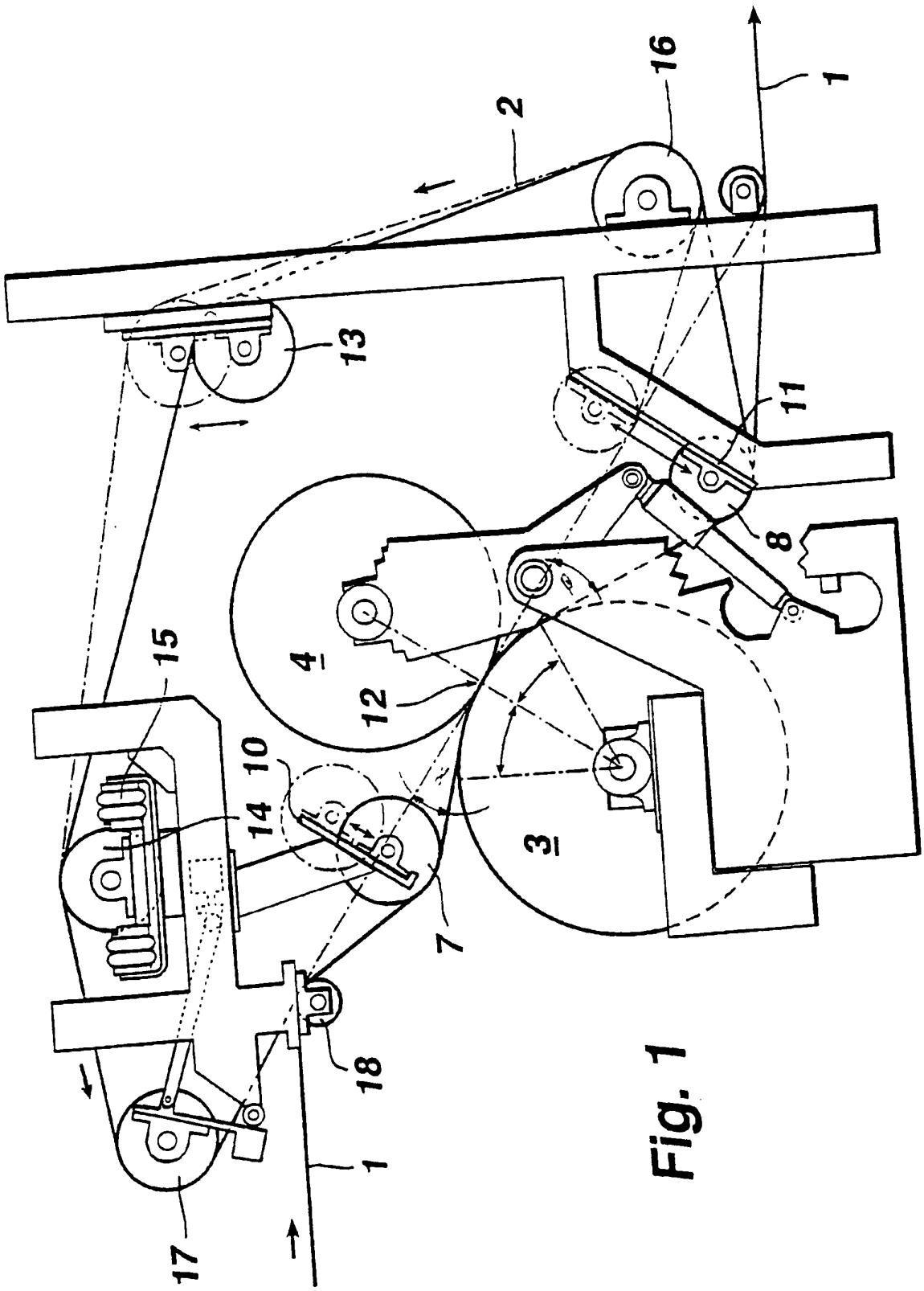

Fig. 1

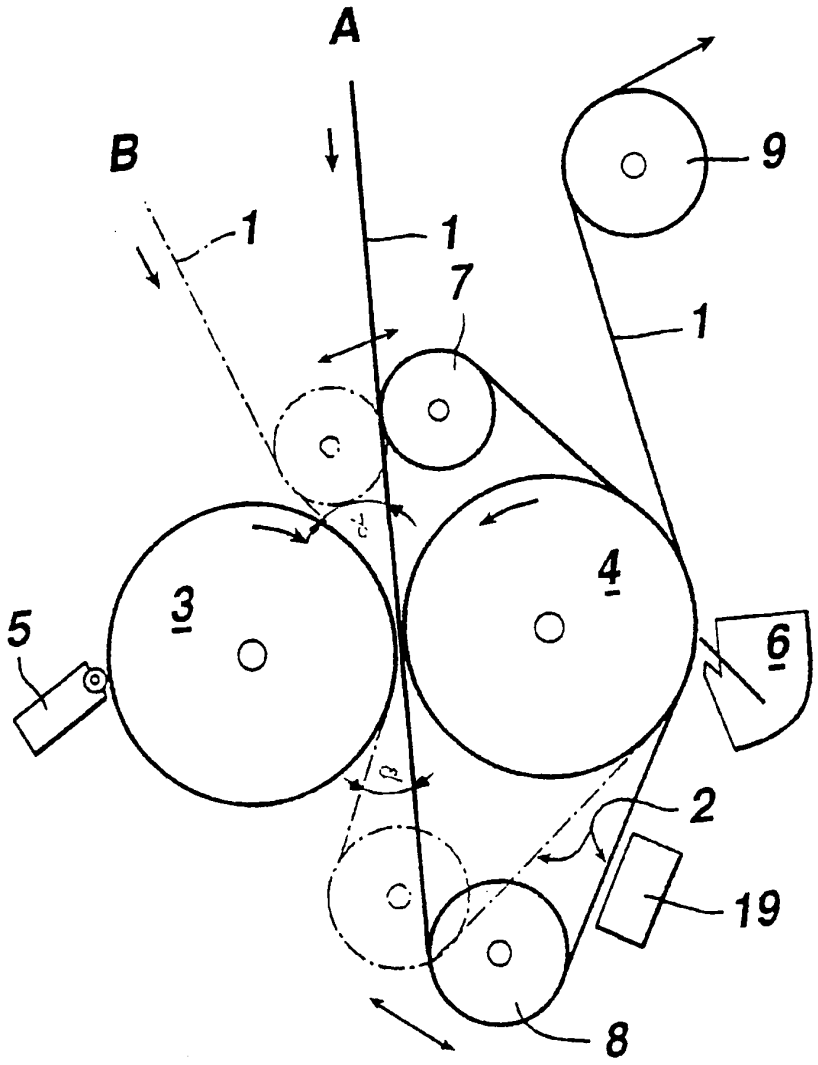

Fig. 2

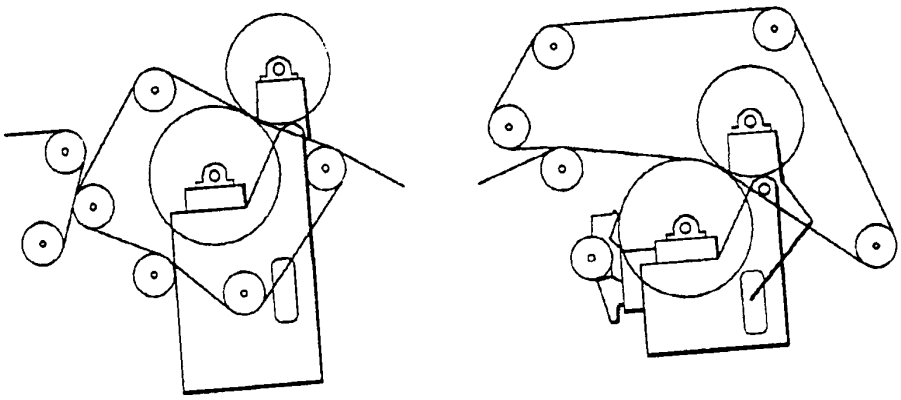

Fig.3

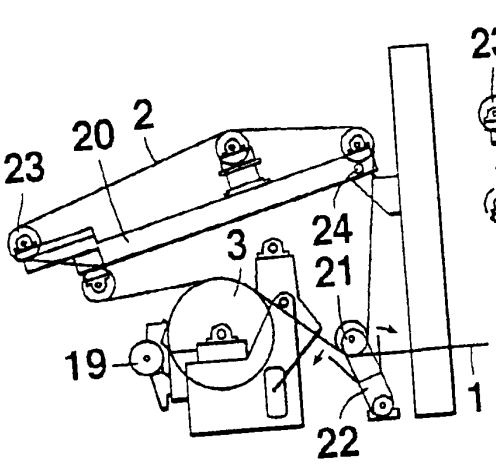

Fig. 4

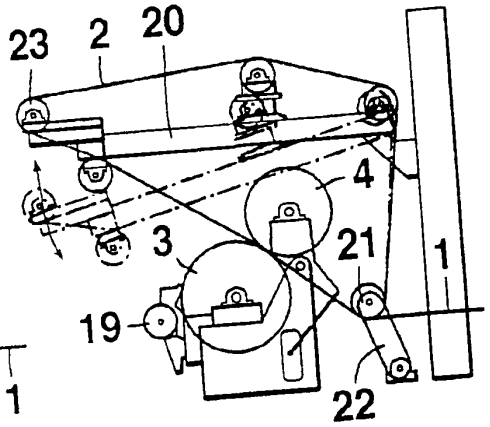

Fig. 5

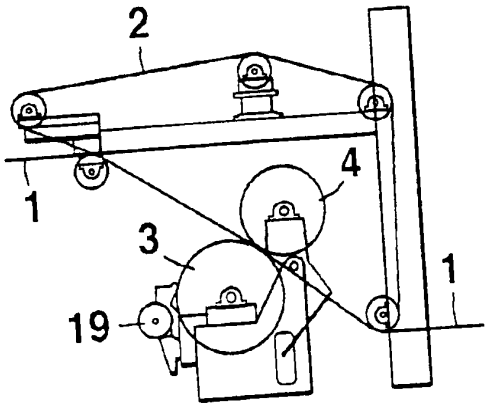

Fig. 6

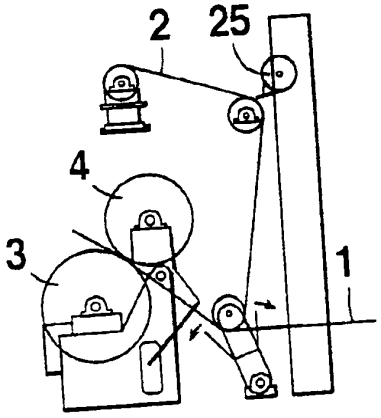

Fig. 7

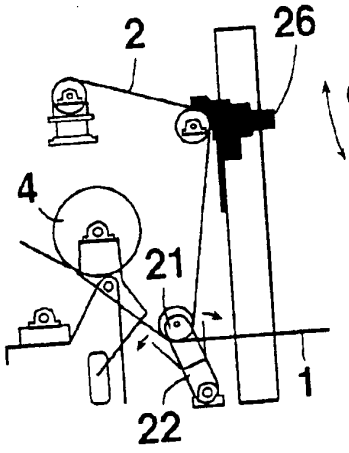

Fig. 8

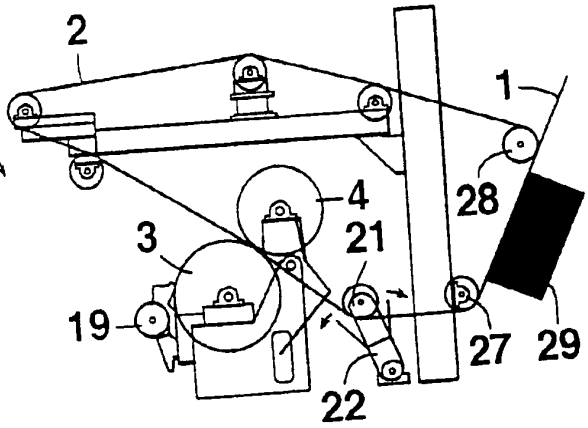

Fig. 9

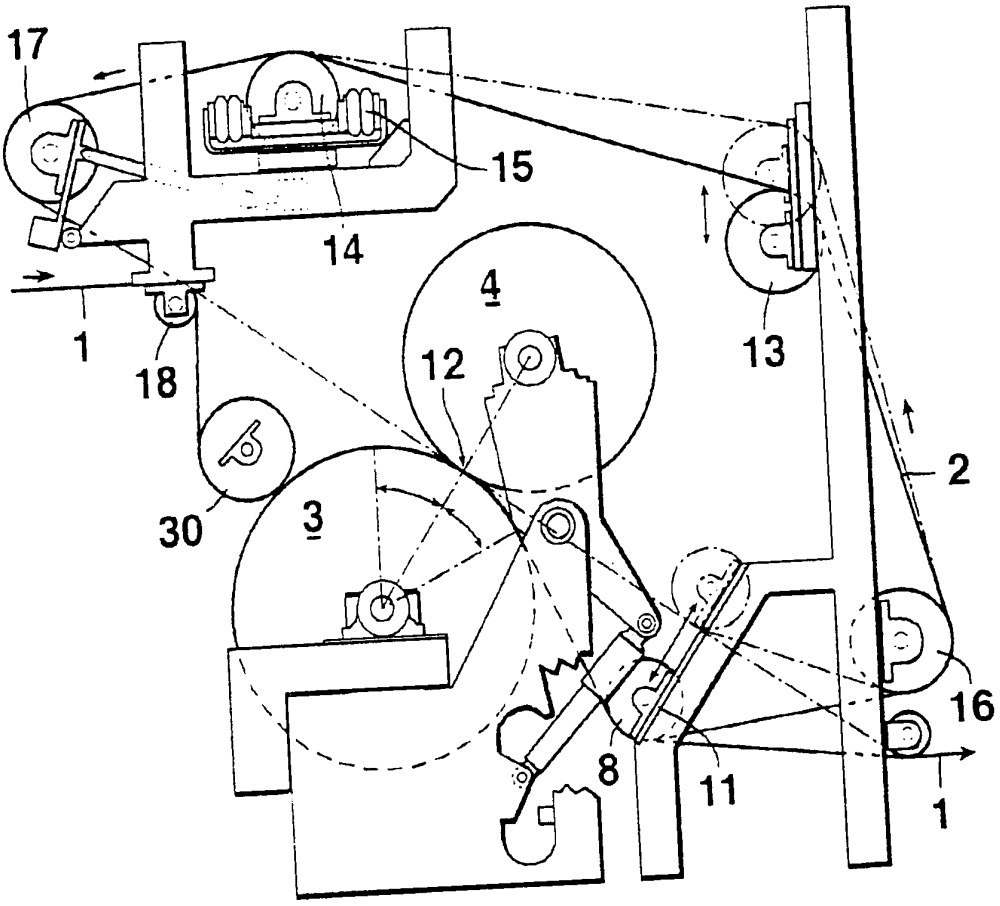

Fig. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 98/00362

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: D21H 23/52, D21H 23/70 // B05C 1/08
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B05C, D21H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E,X	FI 101489 B (VALMET CORPORATION), 30 June 1998 (30.06.98)	1-12,17-26
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Y	US 5547509 A (THOMAS M. NEIDER ET AL), 20 August 1996 (20.08.96), column 3, line 57 - column 4, line 67, abstract	1-30
	--	
Y	WPI accession no. 97-256158, NIPPON SEISHI KK: "Method for printing coated paper - using pair of applicator rolls on which endless belts are bound and passed through nip between rolls to apply coating solution"; & JP,A,9087997, 970331 DW9723	1-30
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 November 1998	01 -12- 1998
Name and mailing address of the ISA/ Swedish Patent Office, Box 5055, S-102 42 STOCKHOLM, Facsimile No. +46 8 666 02 86	Authorized officer: Barbro Nilsson, Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 98/00362

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5340611 A (MARTIN KUSTERMANN ET AL), 23 August 1994 (23.08.94), claim 1 --	1-30
A	US 4928622 A (LENNART LARSSON ET AL), 29 May 1990 (29.05.90), claim 1 --	1-30

INTERNATIONAL SEARCH REPORT

Information on patent family members

03/11/98

International application No.
PCT/FI 98/00362

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FI 101489 B	30/06/98	FI 970387 D	00/00/00
US 5547509 A	20/08/96	NONE	
US 5340611 A	23/08/94	CA 2035061 A	27/07/91
		DE 4002256 A	01/08/91
		DE 59003011 D	00/00/00
		EP 0438743 A,B	31/07/91
		SE 0438743 T3	
		ES 2044390 T	01/01/94
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		DE 3903599 A	24/08/89
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		FR 2627108 A	18/08/89
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		JP 1310768 A	14/12/89
		SE 463135 B,C	15/10/90
		SE 8800470 A	13/08/89